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(54) Small electric commutator motor with capacitor

(57) A miniature electric motor has a tubular housing with a closed end and an open end. The open end is closed by an end cap assembly. The end cap assembly comprises an end cap 26 supporting two motor terminals 30, 32 and two brush assemblies 48, 50. A chip capacitor 34 is connected between the motor terminals. The positive motor terminal 30 is connected to the positive brush assembly 48 by a choke 36 and the negative motor terminal 32 is connected to the negative brush assembly 50 by a PTC 38. The negative motor terminal 32 is also connected to the motor housing by an earth strap 104 which is nipped between the end cap and the motor housing.

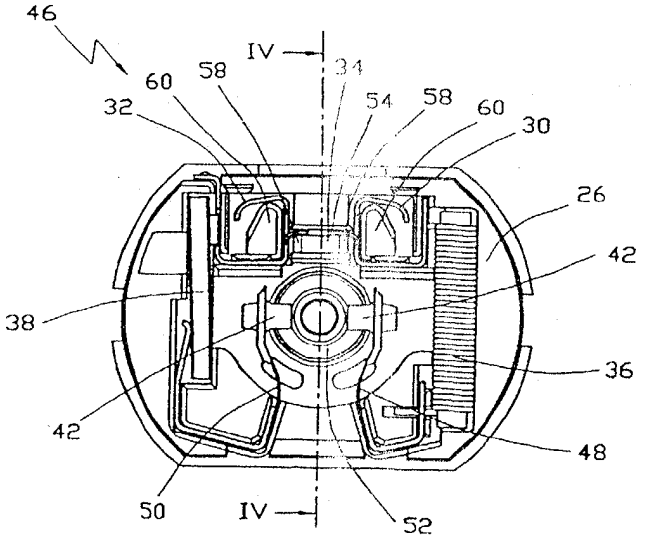

FIG. 3

1 037 364 A1

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 00 30 1846

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report
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14-06-2000

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 30 1846

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	DE 44 30 225 A (MABUCHI MOTOR CO) 29 June 1995 (1995-06-29) * column 1, line 40 - line 48 * * column 6, line 24 - line 37; claim 1; figure 5 *	1	H02K11/02 H02K23/66
D,A	EP 0 607 032 A (MABUCHI MOTOR CO) 20 July 1994 (1994-07-20) * claim 1; figures 4,5 *	1	
A	EP 0 509 683 A (MABUCHI MOTOR CO) 21 October 1992 (1992-10-21) * column 3, line 4 - line 16; claim 1; figures 4,5 *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7) H02K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	14 June 2000	Roy, C

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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L : document cited for other reasons

& : member of the same patent family, corresponding document

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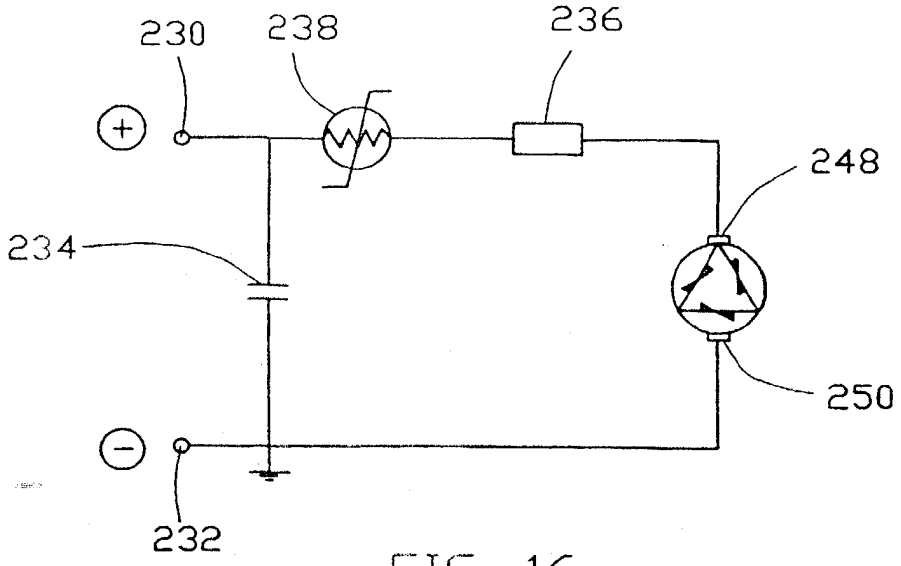
230
238
236
248
234
250
232

FIG. 16

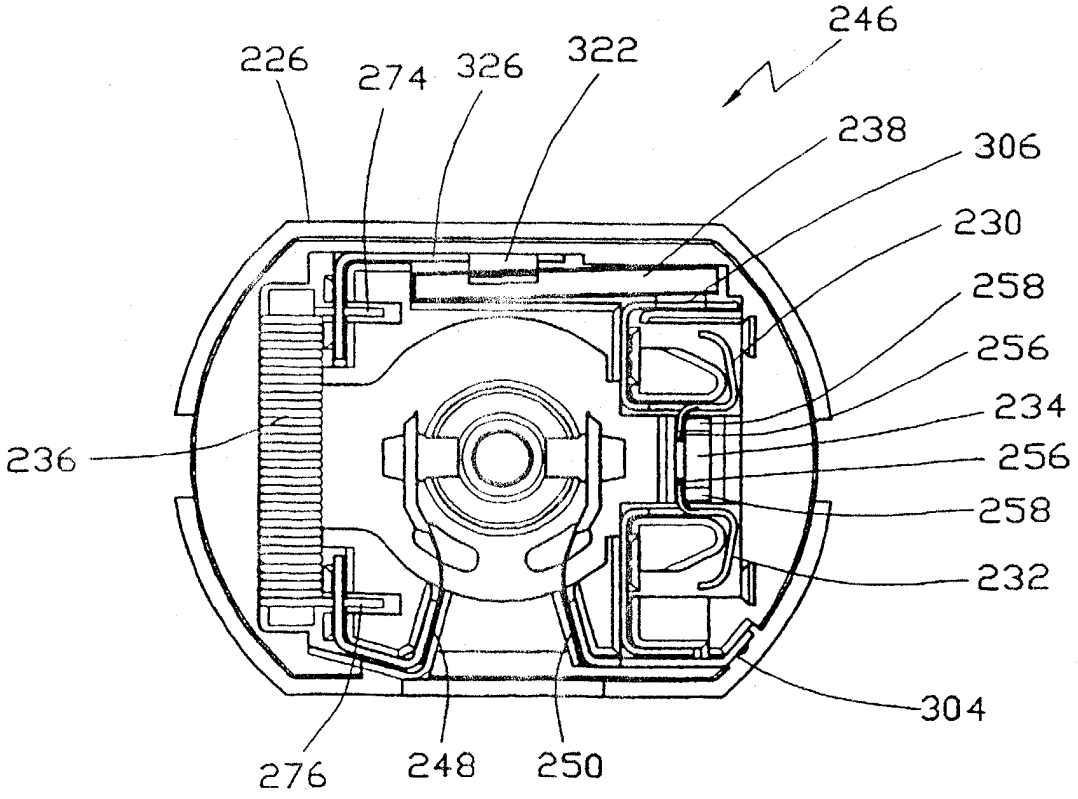
246
226
274
326
322
238
306
230
258
256
234
236
256
258
232
304
276
248
250

FIG. 17

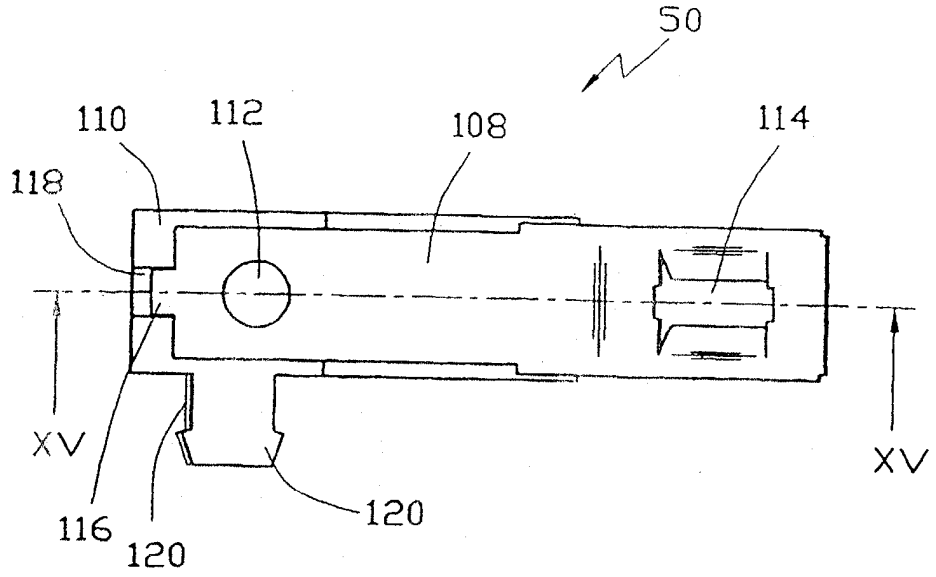
50
110
112
108
114
118
XV
XV
116
120
120

FIG. 14

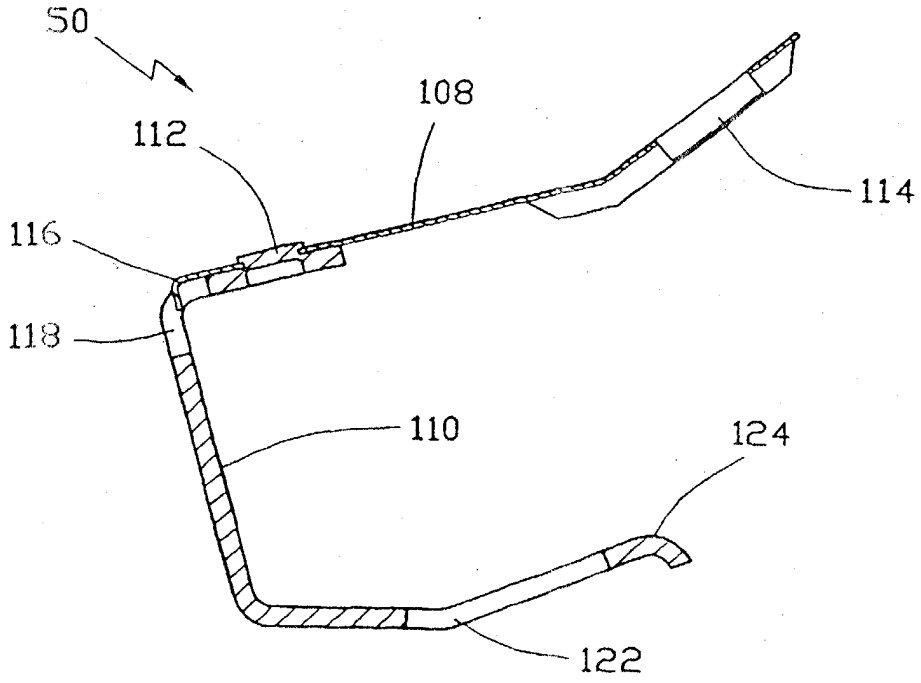
50
108
112
114
116
118
110
124
122

FIG. 15

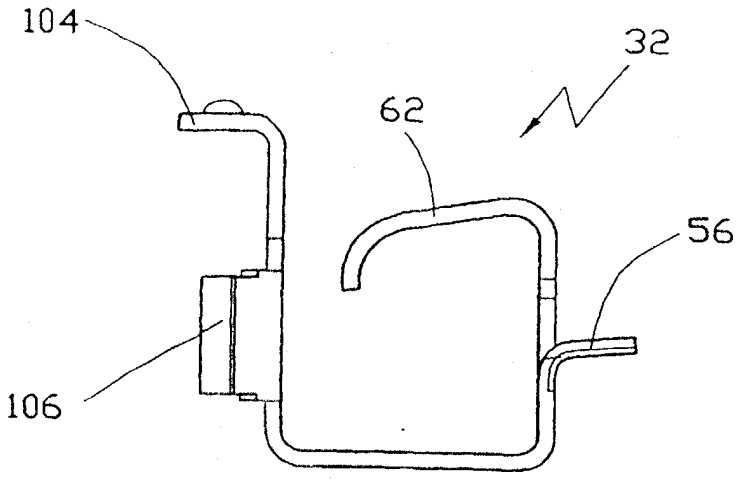

FIG. 12

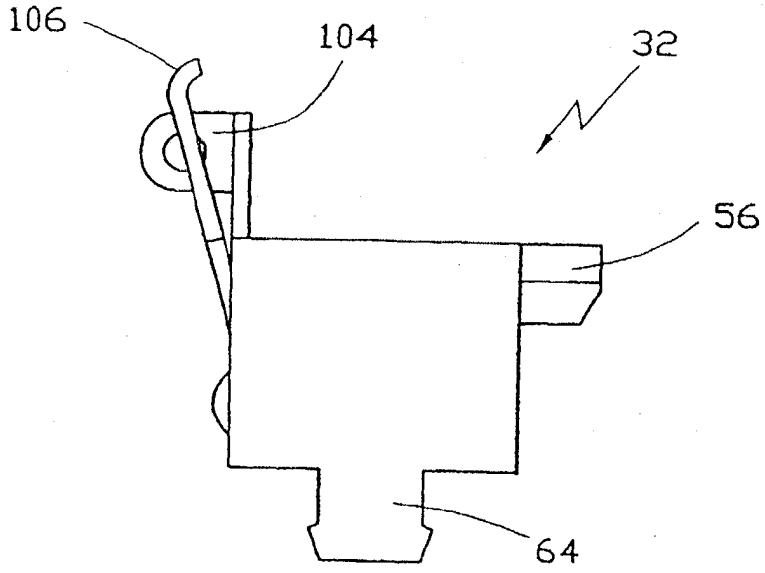

FIG. 13

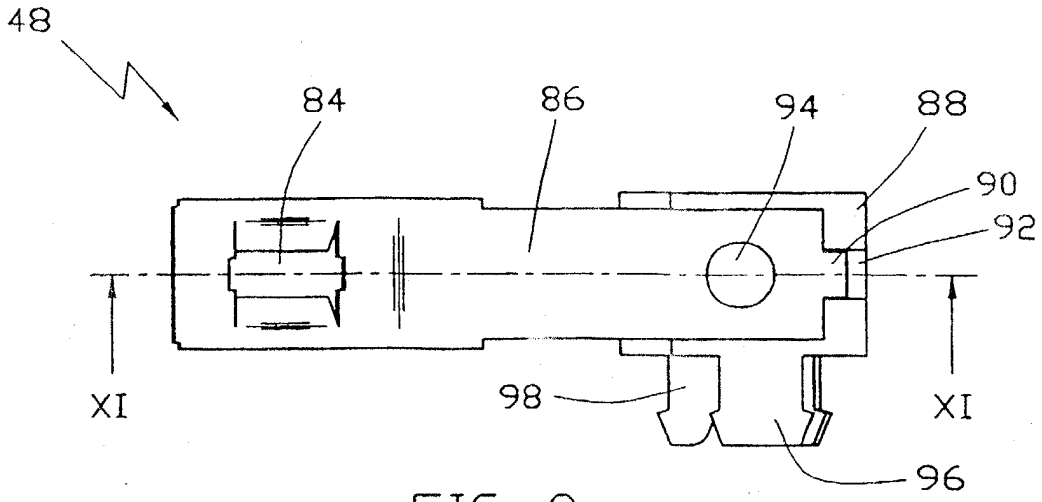

FIG. 9

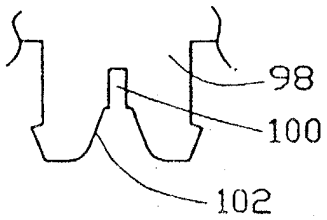

FIG. 10

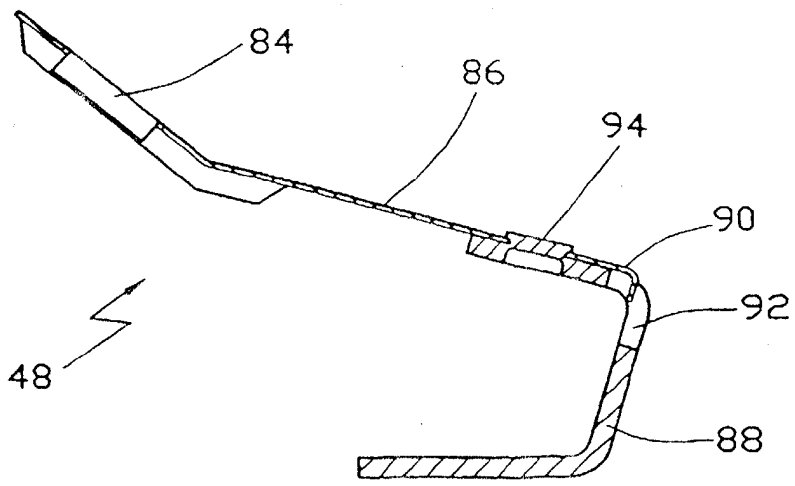

FIG. 11

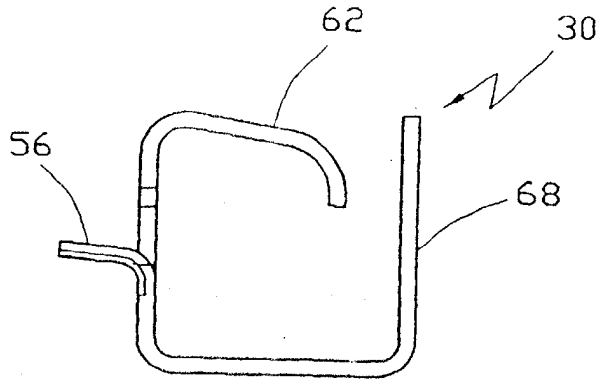

FIG. 5

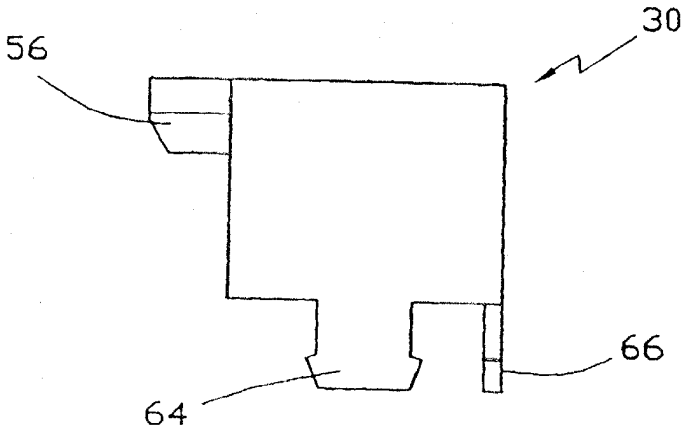

FIG. 6

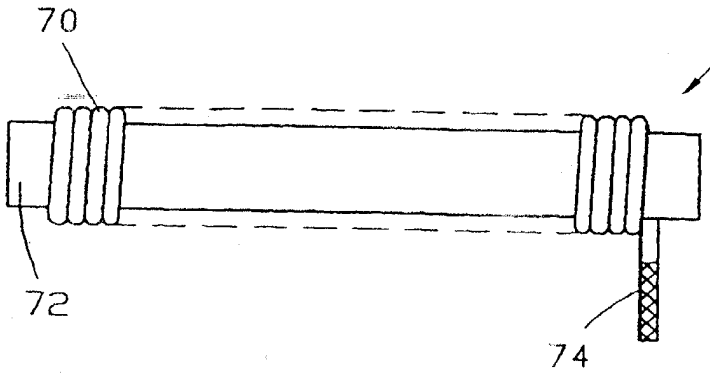

FIG. 7

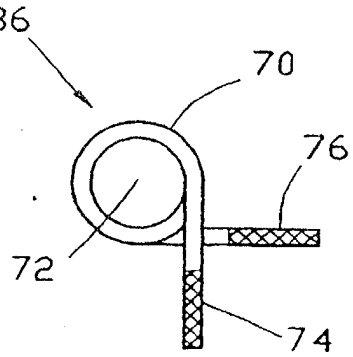

FIG. 8

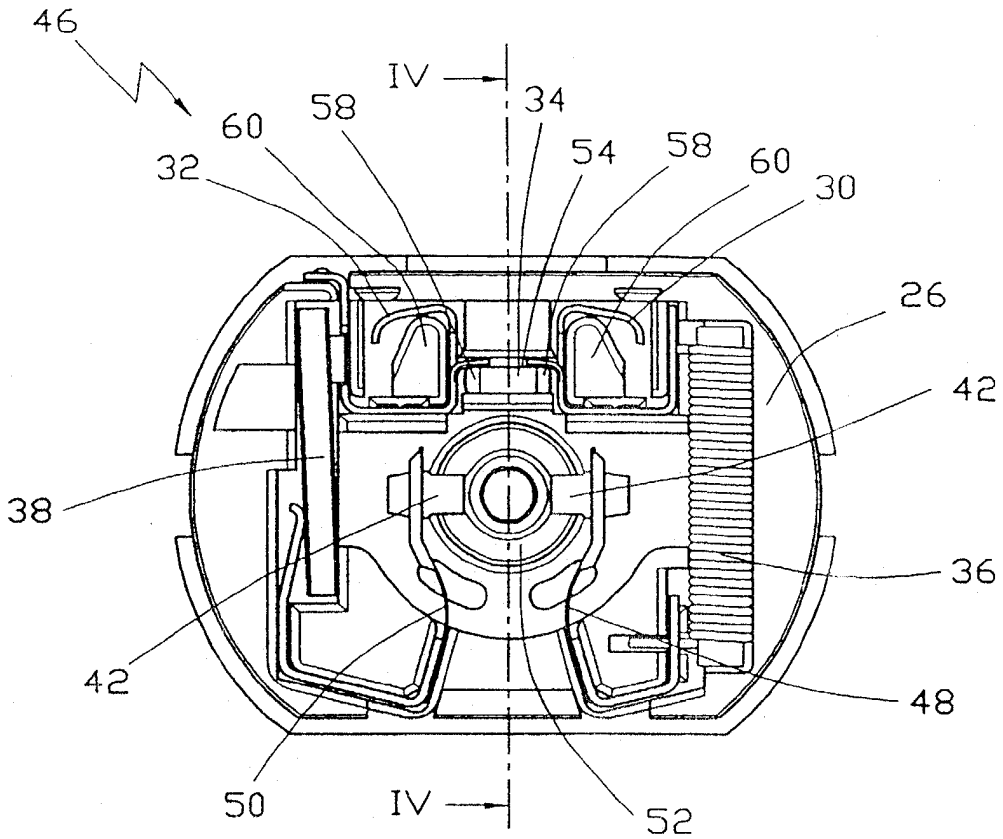
46
IV
34
58
60
54
58
60
32
30
26
42
38
36
42
48
50
IV
52

FIG. 3

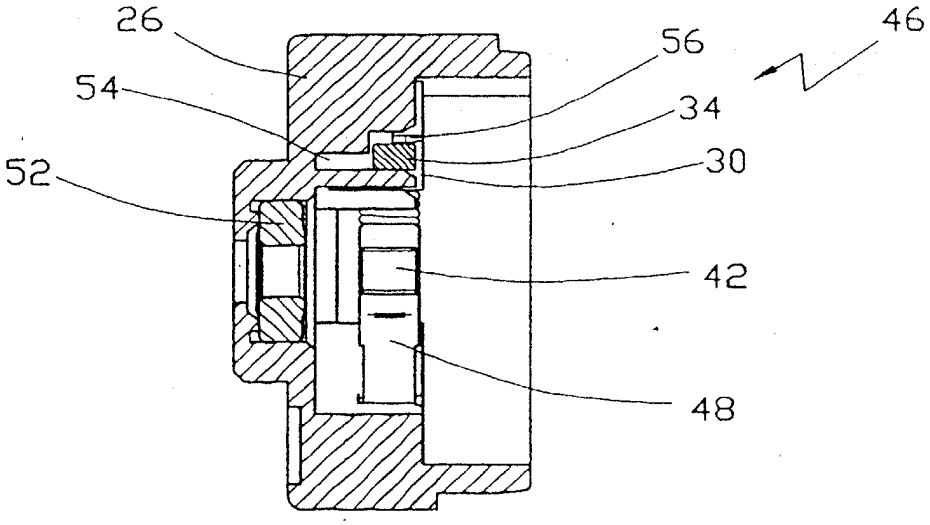
26
56
46
54
34
52
30
42
48

FIG. 4

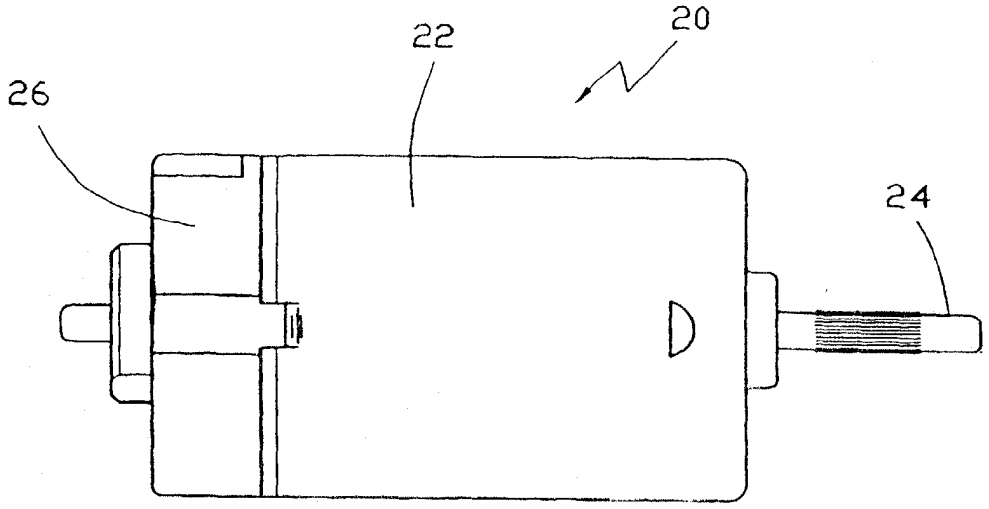

FIG. 1

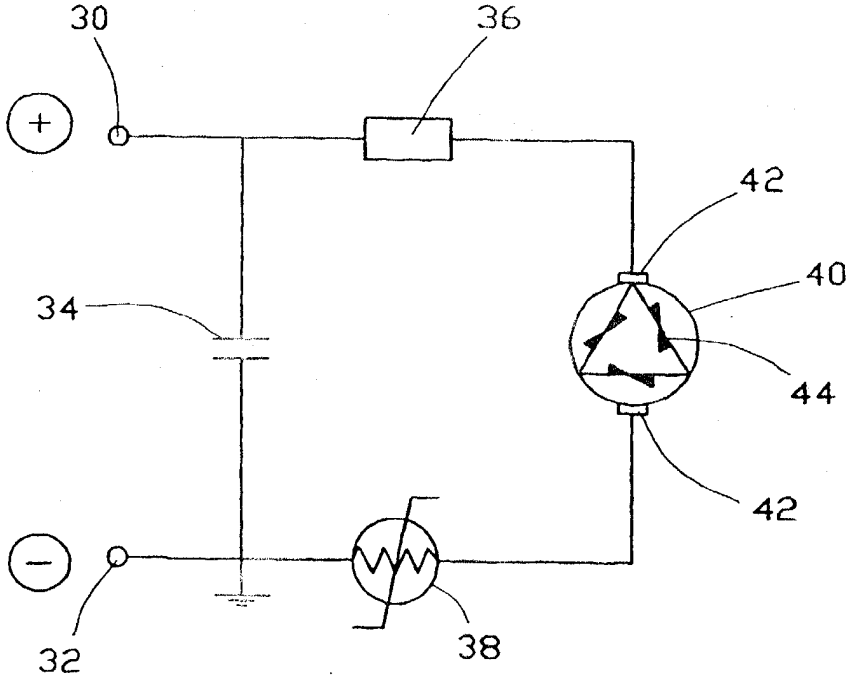

FIG. 2

2. A motor as claimed in claim 1, wherein the chip capacitor (34)(234) is disposed in a groove in the end cap (26)(226);.

3. A motor as claimed in claim 1 or claim 2, wherein the resilient contact means (56)(256) are fingers.

4. A motor according to claim 3, wherein the fingers (56)(256) of the motor terminals engage an outer edge of the side portion of the respective terminal ends (58)(258) of the chip capacitor(34)(234).

5. A motor according to any one of the preceding claims, wherein the motor terminals (30,32)(230, 232) are female type terminals mounted about terminal posts (60) and held to the end cap (26, 226) by barbs (64).

6. A motor according to claim 5, wherein the terminal posts (60) are substantially triangular in section.

7. A motor according to any one of the preceding claims, wherein the end cap (26) has two flat sides connected by two arcuate sides and the motor terminals (30, 32) are located on one flat side.

8. A motor according to any one of claims 1 to 6, wherein the end cap (226) has two flat sides joined by two arcuate sides and the motor terminals (230, 232) are located on one arcuate side.

9. A motor according to any one of the preceding claims, wherein one of the motor terminals (32) is connected to one of the brush assemblies (50) via a positive temperature coefficient thermistor (38).

10. A motor according to any one of the preceding claims, wherein one of the motor terminals (30) is connected to one of the brush assemblies (48) via a choke (36).

11. A motor according to claim 10, wherein the brush assembly (48, 248) connected to the choke (36, 236) has a barb (98) for engaging a groove in the end cap for securing the brush assembly (48, 248) to the end cap (26, 226) and the barb (98) has a slot (100) which straddles and grips a lead (76, 276) from the choke (36, 236) to establish electrical contact therewith.

12. A motor according to claim 11, wherein the motor terminal (30) connected to the choke (36) has a barb (60) which engages a groove in the end cap (26) and the lead (74) from the choke (36) is disposed in the groove so as to be nipped between the groove and the barb (66) of the terminal to establish electrical contact therewith.

13. A motor according to any one of claims 1 to 10, wherein one of the motor terminals (230) is connected to one of the brush assemblies (248) by a positive temperature coefficient thermistor (238) and a choke (236).

14. A motor according to any one of the preceding claims, wherein one of the motor terminals (32) is connected to the motor housing by way of a limb (104) extending from the motor terminal (32) through a recess in the end cap (26) and is nipped between the end cap and the motor housing.

15. A motor according to any one of claims 1 to 13, wherein one of the motor terminals (232) makes direct contact with one of the brush assemblies (250) and the brush assembly (250) includes a brush base fixed to the end cap (226) and supporting a resilient brush arm urging the brush into contact with the commutator, the brush base having further a limb (304) extending through a recess in the end cap and is nipped between the end cap and the motor housing.

into a groove in the end cap to secure the terminal in place. The other end of the terminal has an extension forming an earth strap 104 which passes through a recess in the end cap to the exterior surface of the end cap so that when fitted to the housing, the earth strap is nipped between the end cap and the housing to electrically connect the negative terminal to the housing.

[0022] Adjacent the earth strap is another limb extending upwardly and outwardly. This limb forms a PTC terminal 106 for making a resilient connection with a contact surface of PTC 38. PTC 38 is a slab like metal-polymer-metal type positive temperature coefficient thermistor having parallel planar contact surfaces on opposite surfaces of the slab. The other contact surface is electrically connected to the negative brush assembly 50.

[0023] The negative brush assembly 50 is similar in construction to the positive brush assembly 48 with two main exceptions as shown in Figures 14 and 15 where the negative brush assembly 50 is shown without its brush. The assembly comprises a brush arm 108 held to a brush base 110 by an upset rivet 112. The brush arm has an aperture 114 for receiving and holding the brush and a tail 116 which engages an aperture 118 in the base 110 to prevent the brush pivoting about the rivet 112. The brush base has two barbs 120 which engage grooves in the end cap to secure the brush assembly in position in the end cap. Unlike in the positive brush assembly, neither barb 120 is slotted although one barb is obscured by the other in Figure 14. Another difference is that the negative brush assembly has a limb, extending from the end of the brush base remote from the brush arm, forming a PTC terminal 122. The PTC terminal 122 is a resiliently flexible limb having a contact portion 124 arranged to bear against the other contact terminal of the PTC as shown in the end cap assembly of Figure 3.

[0024] In the embodiment described thus far, the motor terminals are located along one of the flat edges/sides of the end cap. For some cases, it is desirable for the motor terminals to extend from one of the arcuate edges/sides of the end cap. This involves rearranging the components and in one such assembly, the circuit diagram may be as shown in Figure 16 where the PTC 238 is connected between the positive motor terminal 230 and the choke 236 with the negative motor terminal 232 being connected directly to the negative brush assembly 250. Chip capacitor 234 is connected between the two motor terminals. Such an end cap assembly is shown in Figure 17.

[0025] The end cap assembly 246 of Figure 17 has an end cap 226 supporting positive and negative motor terminals 230, 232, a capacitor 234, a choke 236, a PTC 238 and positive and negative brush assemblies 248, 250.

[0026] The capacitor 234 is located in a groove between the two motor terminals 230, 232. Each motor terminal has a limb forming a capacitor terminal 256 making contact with a side of a terminal end 258 of the chip-type capacitor 234.

[0027] The positive motor terminal 230 has a limb forming a PTC terminal 306 for making resilient contact with the PTC. This is similar to the PTC terminal formed in the negative motor terminal of the first embodiment.

[0028] The choke 236 is connected to the positive brush assembly in a manner similar to that of the first embodiment, that is, by a slotted barb on the brush base of the positive brush assembly.

[0029] The choke and PTC are connected together by a link connection 326. Link 326 has a slotted barb similar to that of the positive brush base of the first embodiment for connecting with choke lead 274. Link 326 also has a limb forming a PTC terminal 322 for resilient electrical contact with the PTC 238.

[0030] The negative motor terminal 232 makes direct contact with the brush base 250 of the negative brush assembly. An extension of the free end of the brush base 250 forms the earth strap 304 for connecting the negative motor terminal 232 to the motor housing. Both embodiments function the same way.

[0031] Although two embodiments have been described, other variations and modifications will be apparent to those skilled in the art without departing from the spirit of the invention. For example, the chip capacitor may not be located in a groove in the end cap but merely pressed against a wall formed as part of the end cap by the resilient contact members. It is intended that all such variations and modifications will be covered by the invention as defined by the following claims.

Claims

1. A miniature electric motor comprising a housing (22) having an open end;

a permanent magnet stator fitted to the housing;
a rotor having an armature and a commutator;
an end cap (26)(226) engaging the open end of the housing;
two brush assemblies (48, 50)(248, 250) supported by the end cap (26)(226) and including brushes (42) in sliding contact with the commutator;
two motor terminals (30, 32)(230, 232) connected to the brush assemblies (48, 50)(248, 250) and supported by the end cap (26)(226);
bearings supporting the rotor for rotation in the housing; and
a chip capacitor (34)(234) supported by the end cap (26)(226);
characterised in that
resilient contact means (56)(256) integral with the motor terminals (30, 32)(230, 232) directly engage respective side portions of terminal ends of the chip capacitor (34)(234).

brush assembly of Figure 9;

Figure 12 is a plan view of a negative motor terminal of the end cap assembly of Figure 3;

Figure 13 is a side view of the negative motor terminal of Figure 12;

Figure 14 is a side view of a negative brush assembly, without a brush, of the end cap assembly of Figure 3;

Figure 15 is a sectional view of the negative brush assembly of Figure 14 without the brush;

Figure 16 is a motor circuit diagram of an alternative motor arrangement; and

Figure 17 is a view similar to Figure 3 of an alternative end cap assembly for the motor of Figure 16.

[0014] Figure 1 illustrates a miniature d.c. motor 20 having a wound rotor and a permanent magnet stator. The motor has a housing 22 in the form of a deep drawn can with a closed end and an open end. The housing 22 houses a permanent magnet stator which surrounds a wound rotor fitted to a motor shaft. An end cap 24 closes the open end of the housing and supports motor terminals, brush gear and other components. The housing and thus, the end cap, has two flat sides interconnected by two arcuate sides.

[0015] Figure 2 is a circuit diagram of the motor illustrating the electrical components and their interconnections. From this diagram, it can be seen that there is a positive motor terminal 30 and a negative motor terminal 32. A capacitor 34 is connected between the two terminals. A choke 36 is connected to the positive terminal 30 and a PTC (positive temperature coefficient thermistor) 38 is connected to the negative motor terminal 32. The choke 36 and PTC 38 are connected to the rotor 40 via brushes 42 rubbing on a commutator. The rotor 40 is fitted with a varistor 44. The negative terminal 32 is also earthed which means it is connected to the motor housing.

[0016] Figure 3 shows the inside of an end cap assembly 46 of the motor of Figure 1 while Figure 4 is a sectional view cut along line IV-IV of Figure 3. As can be seen, the end cap assembly 46 is very compact and comprises a plastics material end cap 26 supporting positive and negative motor terminals 30, 32, a chip-type capacitor 34, a choke 36, a PTC 38, two brush assemblies 48, 50 and a bearing 52. The chip capacitor 34 is located in a groove 54 in the end cap between the two motor terminals. Each motor terminal 30, 32 has a limb 56 which extends into the groove 54 and makes contact with an edge or corner region of a respective terminal end 58 of the chip capacitor 34, urging the capacitor into contact with a wall of the groove 54 and pivoting the capacitor slightly within the groove, thus holding the capacitor more securely.

[0017] Each motor terminal 30, 32 is of the female type and is located about a terminal post 60 which protects the motor terminals from an overly aggressive insertion of a male terminal. The terminal posts 60 are substantially triangular in plan allowing a contact arm 62 of each motor terminal a large range of motion while supporting the arm against overbending which would permanently bend the contact arm reducing its spring contact force and thus, reliability.

[0018] The positive motor terminal 30 is shown in Figures 5 and 6 where it can be seen that the terminal is shaped from a strip of sheet material and bent into a square shape with the capacitor terminal 56 extending from one side. In Figure 6, two barbs 64, 66 are visible. The barbs extend into and engage recesses in the end cap to hold the terminal in place. The barb 66 on the end portion 68 is also used as a terminal for connection to the choke.

[0019] The choke 36, shown in Figures 7 and 8, is a length of enamelled copper wire 70 wound around a ferrite rod 72. The ends 74, 76 of the copper wire, also known as the leads of the choke, are tinned by dipping in solder to remove the insulating enamel. The terminal end lead 74 of the choke is placed in the second groove of the positive terminal and then the positive terminal is pressed into the end cap, the choke lead 74 being nipped between the groove and the second barb 66 ensuring a good, stable electrical contact.

[0020] The choke 36 is located in another groove 78 in the end cap (see Figure 3). The brush end lead 76 of the choke is located in a small lateral extension 80 of the groove 78 for connecting to the positive brush assembly 48. The brush assembly 48 comprises a brush 42 of carbon based material pressed into a receiving aperture 84 of a resilient conductive brush arm 86. The brush arm 86 is upset riveted to a brush base 88. The assembly 48 without the brush is shown in Figures 9 and 11. A small tail 90 extends from the proximal end of the brush arm and locates in an aperture 92 in the brush base to prevent the brush arm pivoting about the rivet 94. The brush base has two barbs 96, 98 which extend into grooves in the end cap to hold the brush assembly in place. The second barb 98 which is partly obscured in Figure 9 and shown in detail in Figure 10 has a central slot 100 with a tapered mouth 102. This barb 98 forms a choke terminal and is pressed over the terminal end lead 76 of the choke 36 to make a reliable electrical connection between the positive brush assembly 48 and the choke 36.

[0021] The negative motor terminal is shown in Figures 12 and 13. The negative terminal is similar to the positive terminal being somewhat square in plan view with the contact arm end and capacitor terminal being a mirror image of the corresponding portions of the positive terminal. This motor terminal has a single barb 64 extending from a midsection of the negative terminal

Description

[0001] This invention relates to small electric motors and in particular, to the end cap assembly for an electric motor of a direct current permanent magnet stator type.

[0002] It is often desired to reduce the amount of electrical noise generated by an electric motor. This is done by adding a capacitor or other electronic components to the motor circuit. Typically, a capacitor is connected between the motor terminals and because of their size, the capacitor is mounted on the outside of the motor where it is subject to physical damage. With the advent of chip-type capacitors, it has been possible to fit the capacitor to the inside of the motor end cap. One such arrangement is shown in EP 0607032 A1 where a chip capacitor is pressed into contact with a motor terminal by a conductive spring bearing against the other terminal, like a battery in a torch. While this is very simple, it does require the assembly of the chip and the spring into a slot in the end cap.

[0003] The present invention aims to simplify assembly even further by eliminating the need for the separate spring. Certain embodiments build upon the compact nature of the end cap by incorporating further noise suppression or motor protection devices such as chokes, surge suppressors and overcurrent/overtemperature protection devices.

[0004] Accordingly, the present invention provides a miniature electric motor comprising a housing having an open end; a permanent magnet stator fitted to the housing; a rotor having an armature and a commutator; an end cap engaging the open end of the housing; two brush assemblies supported by the end cap and including brushes in sliding contact with the commutator; two motor terminals connected to the brush assemblies and supported by the end cap; bearings supporting the rotor for rotation in the housing; and a chip capacitor supported by the end cap; wherein resilient contact means integral with the motor terminals directly engage respective side portions of terminal ends of the chip capacitor.

[0005] Preferably, the chip capacitor is disposed in a groove in the end cap. The use of a groove helps to locate the capacitor during assembly.

[0006] Preferably, the resilient contact means are fingers. The use of fingers extending from the motor terminals and engaging a side of the respective terminal ends of the chip capacitor has the advantage of being less sensitive to variations in the length of the chip as while the thickness of the chip is controlled, the length can vary significantly due to manufacturing tolerances.

[0007] Preferably, the fingers of the motor terminals engage an outer longitudinal edge of the terminal ends of the chip capacitor. If the capacitor is disposed in a groove in the end cap this will cause the chip capacitor to pivot within the groove and partially blocking the groove thereby making resilient contact with the capacitor and retaining it within the groove.

[0008] Preferably, the end cap assembly includes a choke connected between one brush terminal and one motor terminal.

[0009] Preferably, the end cap assembly includes a positive temperature coefficient thermistor connected between one motor terminal and one brush assembly.

[0010] Preferably, the motor terminals are female terminals supported by respective terminal posts integral with the end cap. Female terminals make for a more compact motor but add considerably to the space constraints within the end cap.

[0011] Preferably, the terminal posts are substantially triangular in section. This arrangement allows the contact portion of the motor terminal a wide range of resilient movement while supporting it against excessive movement which would deform the terminal.

[0012] Preferably, the motor housing and end cap have two flat sides connected by two arcuate sides and the motor terminals are located along one of the flat sides. Alternatively, the motor terminals may be located along one of the arcuate sides of the end cap assembly.

[0013] Two preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a view of a motor according to the present invention;

Figure 2 is a circuit diagram of the motor of Figure 1;

Figure 3 is an inside view of an end cap assembly of the motor of Figure 1;

Figure 4 is a sectional view of the end cap assembly of Figure 3;

Figure 5 is a plan view of a positive terminal of the end cap assembly of Figure 3:

Figure 6 is a side view of the positive terminal of Figure 5;

Figure 7 is a side view of a choke of the end cap assembly of Figure 3,

Figure 8 is an end view of the choke of Figure 7;

Figure 9 is a side view of a positive brush assembly, without a brush, of the end cap assembly of Figure 3;

Figure 10 is a partial view of the positive brush assembly of Figure 9 showing in detail a connector for a choke lead;

Figure 11 is a sectional view from below of the